

Name_____

Chemistry I: Bonding Unit Worksheet

Period_____

Date_____

Chemical Bonding

IONIC AND METALLIC BONDING

SECTION 7.1 IONS (pages 187–193)

This section explains how to use the periodic table to infer the number of valence electrons in an atom and draw its electron dot structure. It also describes the formation of cations from metals and anions from nonmetals.

Valence Electrons (pages 187–188)

1. What are valence electrons?_____
2. The valence electrons largely determine the _____ of an element and are usually the only electrons used in _____.
3. true or false? The group number of an element in the periodic table is related to the number of valence electrons it has. _____
4. What is an electron dot structure?_____

The Octet Rule (page 188)

5. What is the octet rule?_____
6. Metallic atoms tend to lose their valence electrons to produce a(n) _____ or a positively charged ion.
Most nonmetallic atoms achieve a complete octet by gaining or _____ electrons.

Formation of Cations (pages 188–190)

7. Write the electron configurations for these metals and circle the electrons lost when each metal forms a cation.

a. Mg _____

b. Al _____

c. K _____

Match the noble gas with its electron configuration.

_____ 8. argon

a. $1s^2$

_____ 9. helium

b. $1s^2 2s^2 2p^6$

_____ 10. neon

c. $1s^2 2s^2 2p^6 3s^2 3p^6$

_____ 11. krypton

d. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$

12. What is the electron configuration called that has 18 electrons in the outer energy level and all of the orbitals filled? _____

Formation of Anions (pages 191–192)

13. Atoms of most nonmetallic elements achieve noble-gas electron configurations by gaining electrons to become _____, or negatively charged ions.

14. What property of nonmetallic elements makes them more likely to gain electrons than lose electrons? _____

15. True or false? Elements of the halogen family lose one electron to become halide ions. _____

16. How many electrons will each element gain in forming an ion?

a. nitrogen _____

b. oxygen _____

c. sulfur _____

d. bromine _____

17. Write the symbol and electron configuration for each ion from Question 19, and name the noble gas with the same configuration.

a. nitride _____

b. oxide _____

c. sulfide _____

d. bromide _____

SECTION 7.2 IONIC BONDS AND IONIC COMPOUNDS (pages 194–199)

This section lists the characteristics of an ionic bond. It also describes the use of these characteristics to explain the electrical conductivity of ionic compounds when melted and when in aqueous solutions.

Formation of Ionic Compounds (pages 194–195)

18. What is an ionic bond? _____

19. In an ionic compound, the charges of the _____ and _____ must balance to produce an electrically _____ substance.

20. A chemical formula shows the types and _____ of atoms in the smallest representative unit of a substance.

21. List the numbers and types of atoms represented by these chemical formulas.

a. Fe_2O_3 _____

b. KMnO_4 _____

c. CH_4 _____

d. NH_4NO_3 _____

22. What is a formula unit? _____

23. Explain why the ratio of magnesium ions to chloride ions in MgCl_2 is 1:2. _____

24. Describe the structure of ionic compounds. _____

Properties of Ionic Compounds (pages 196–198)

25. Most ionic compounds are _____ at room temperature.

26. True or false? Ionic compounds generally have low melting points. _____

27. Circle the letter of each statement that is true about ionic compounds.

- a. When dissolved in water, ionic compounds can conduct electricity.
- b. When melted, ionic compounds do not conduct electricity.
- c. Ionic compounds have very unstable structures.
- d. Ionic compounds are electrically neutral.

SECTION 7.3 BONDING IN METALS (pages 201–203)

This section uses the theory of metallic bonds to explain the physical properties of metals. It also describes the arrangements of atoms in some common metallic crystal structures.

Metallic Bonds and Metallic Properties (pages 201–202)

28. True or false? Metals are made up of cations, not neutral atoms. _____

29. What are metallic bonds? _____

30. Name three properties of metals that can be explained by metallic bonding.

a. _____

b. _____

c. _____

31. What happens to an ionic crystal when a force is applied to it? _____

Crystalline Structure of Metals (page 202)

32. Metal atoms in crystals are arranged into very _____ and orderly pattern.

COVALENT BONDING

SECTION 8.1 MOLECULAR COMPOUNDS (pages 213–216)

This section explains how to distinguish between ionic and molecular compounds.

Molecules and Molecular Compounds (pages 213–214)

33. What is a covalent bond? _____

34. Most elements found in nature, with the exception of the _____ exist as molecules.

3. What is a molecule? _____

35. Compounds that are formed when two or more atoms combine to form molecules are called _____ .

36. Circle the letter of the substances that do NOT exist as molecules in nature.

- a. oxygen
- b. water
- c. neon
- d. ozone
- e. helium

37. List two properties of molecular compounds.

a. _____

b. _____

Molecular Formulas (pages 215–216)

38. What is a molecular formula? _____

Match each compound with its molecular formula.

_____ **39.** carbon dioxide a. C_2H_6

_____ **40.** ethane b. CO_2

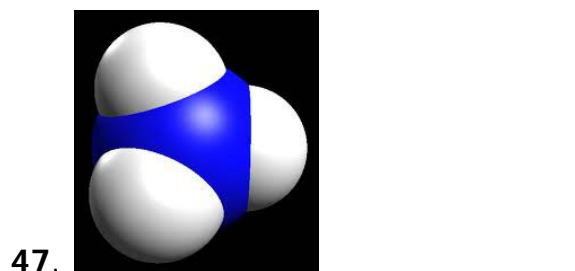
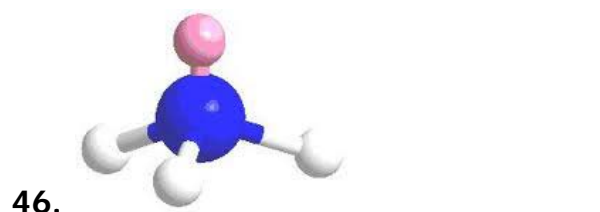
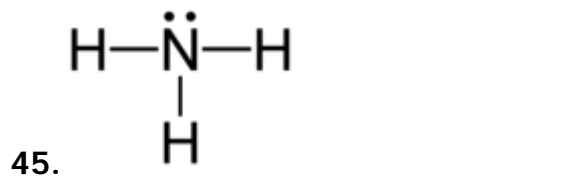
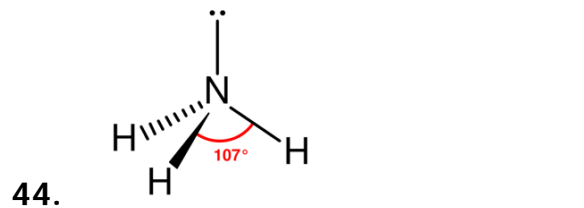
_____ **41.** ammonia c. NH_3

42. True or false? A molecular formula shows the arrangement of the atoms in a molecule. _____

43. In the diagram, match the type of model or formula with its representation.

a. ball-and-stick model b. molecular formula c. perspective drawing

d. space-filling molecular e. structural formula



SECTION 8.2 THE NATURE OF COVALENT BONDING (pages 217–220)

This section uses electron dot structures to show the formation of single, double, and triple covalent bonds. It also describes and gives examples of coordinate covalent bonding, resonance structures, and exceptions to the octet rule.

The Octet Rule in Covalent Bonding (page 217)

48. How does electron sharing occur in forming covalent bonds? _____

Single Covalent Bonds (pages 217–220)

49. True or false? A shared pair of electrons is represented by a double dash. _____

50. Structural formulas show the arrangement of _____ in molecules.

51. Use the electron dot diagram below. Circle each unshared pair of electrons in a water molecule.

Double and Triple Covalent Bonds (pages 221–222)

52. A chemical bond formed when atoms share two pairs of electrons is called

a (n) _____

53. How many covalent bonds are in the nitrogen molecule? _____

54. True or false? All diatomic molecules contain double bonds. _____

Coordinate Covalent Bonds (pages 223–225)

55. What is a coordinate covalent bond? _____

56. Look at Table 8.2 on page 224. Which two nitrogen compounds contain coordinate covalent bonds? _____

Bond Dissociation Energies (page 226)

57. What is bond dissociation energy? _____

Resonance (pages 227–228)

58. The actual bonding in ozone is a _____ of the extremes represented by its _____.

59. What are resonance structures? _____

Exceptions to the Octet Rule (pages 228–229)

60. Why does NO_2 not follow the octet rule? _____

SECTION 8.3 BONDING THEORIES (pages 230–236)

This section describes the molecular orbital theory of covalent bonding, including orbital hybridization. It also explains the use of VSEPR theory to predict the shapes of some molecules.

Molecular Orbitals (pages 230–231)

61. What is a molecular orbital? _____

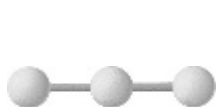
VSEPR Theory (pages 232–233)

62. What is VSEPR theory? _____

63. When the central atom of a molecule has unshared electrons, the bond angles will be _____ than when all the central atom's electrons are shared.

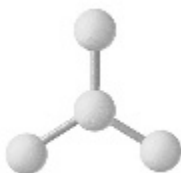
64. What is the bond angle in carbon dioxide? Why? _____

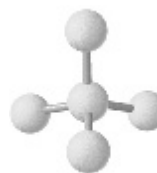
65. What are the names of these common molecular shapes?











Hybrid Orbitals (pages 234–236)

66. True or false? Orbital hybridization theory can describe both the shape and bonding of molecules. _____

67. What is orbital hybridization? _____

Match the hybrid orbitals formed by carbon with the carbon compound in which they are found.

_____ 68. sp^3

a. ethyne

_____ 69. sp^2

b. ethene

_____ 70. sp

c. methane

SECTION 8.4

POLAR BONDS AND MOLECULES (pages 237–244)

This section explains the use of electronegativity values to classify a bond as nonpolar covalent, polar covalent, or ionic. It also names and describes the weak attractive forces that hold groups of molecules together.

Bond Polarity (pages 237–238)

71. True or false? Covalent bonds differ in the way electrons are shared by the bonded atoms, depending on the kind and number of atoms joined together. _____

72. Describe how electrons are shared in each type of bond. Write *equally* or *unequally*.

a. Nonpolar bond _____

b. Polar bond _____

73. Why does the chlorine atom in hydrogen chloride acquire a slightly negative charge?

74. What symbols are used to represent the charges on atoms in a polar covalent bond? The polarity of the bond? _____

Match the electronegativity difference range with the most probable type of bond that will form.

_____ **75.** 0.0–0.4

a. ionic

_____ **76.** 0.4–1.0

b. nonpolar covalent

_____ **77.** 1.0–2.0

c. very polar covalent

_____ **78.** >2.0

d. moderately polar covalent

Reading Skill Practice

You can increase your understanding of what you have read by making comparisons. A compare/contrast table can help you do this. On a separate sheet of paper, draw a table to compare the three types of hybrid orbitals as explained on pages 235 and 236. The three heads for the rows should be sp , sp^2 , and sp^3 . Then list the characteristics that will form the basis of your comparison above each column. The column heads should be *Number of Hybrid Orbitals*, *Component Orbitals*, *Number of Bonds*, and *Bond Angle*. **10 EC PTS**

Polar Molecules (pages 239–240)

79. Circle the letter of each sentence that is true about polar molecules.

- a. Some regions of a polar molecule are slightly negative and some are slightly positive.
- b. A molecule containing a polar bond is always polar.
- c. A molecule that has two poles is called a dipolar molecule.
- d. When polar molecules are placed in an electric field, they all line up with the same orientation in relation to the charged plates.

80. Are the following molecules polar or nonpolar?

- a. H_2O _____
- b. CO_2 _____
- c. NH_3 _____
- d. HCl _____

Attractions between Molecules (pages 240–241)

81. What causes dispersion? _____

82. Is the following sentence true or false? Dispersion forces generally increase in strength as the number of electrons in a molecule increases. _____

83. The strongest of the intermolecular forces are _____ .

Intermolecular Attractions and Molecular Properties (pages 243–244)

84. What determines the physical properties of a compound? _____

85. Use Table 8.4 on page 244. Complete the following table comparing ionic and covalent compounds.

Characteristic	Ionic Compound	Covalent Compound
Representative unit		
Physical state		
Melting point		
Solubility in water		